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Brown Bear (*Ursus arctos*) Predation of Broad Whitefish (*Coregonus nasus*) in the Mackenzie Delta Region, Northwest Territories

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ABSTRACT. On 2 October 2007, we observed evidence of at least one brown bear (*Ursus arctos*) predating and caching broad whitefish (*Coregonus nasus*) at Pete's Creek, a tributary of the Mackenzie River, Northwest Territories. While predation on whitefish by brown bears has been reported as traditional ecological knowledge in the Northwest Territories, accounts in the scientific literature of brown bears feeding on fish other than salmon, trout (*Oncorhynchus* spp.), and charr (*Salvelinus* spp.) are rare, particularly for North America. As a spatially concentrated, high-quality food in a resource-poor landscape, migrating broad whitefish may play an important role in the foraging ecology of some Arctic brown bears.

Key words: Northwest Territories, Mackenzie Delta, brown bear, grizzly bear, *Ursus arctos*, broad whitefish, *Coregonus nasus*, traditional knowledge, predation

RÉSUMÉ. Le 2 octobre 2007, nous avons observé au moins un ours brun (*Ursus arctos*) en train de s'attaquer à un corégone tschir (*Coregonus nasus*) et de le cacher à Pete's Creek, un affluent du fleuve Mackenzie, dans les Territoires du Nord-Ouest. Bien que les connaissances écologiques traditionnelles des Territoires du Nord-Ouest attestent de la prédation de corégones par les ours bruns, il est rare que la documentation scientifique démontre que les ours bruns mangent du poisson autre que le saumon, la truite (*Oncorhynchus* spp.) et l'omble chevalier (*Salvelinus* spp.), particulièrement en Amérique du Nord. En tant que source alimentaire de grande qualité concentrée dans cet espace et ce paysage pauvre en ressources, le corégone tschir en migration pourrait jouer un rôle important dans l'écologie alimentaire de certains ours bruns de l'Arctique.

Mots clés : Territoires du Nord-Ouest, delta du Mackenzie, ours brun, grizzli, *Ursus arctos*, corégone tschir, *Coregonus nasus*, connaissances traditionnelles, prédation

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INTRODUCTION

Fish provide a lipid-rich, highly digestible, and spatially concentrated food source for many brown bear populations, and predation on salmon, trout (*Oncorhynchus* spp.), and charr (*Salvelinus* spp.) by bears is well documented (Kistchinski, 1972; Reinhart and Mattson, 1990; Hilderbrand et al., 1999a, b; Mowat and Heard, 2006). The Mackenzie Delta, however, lacks major runs of salmon, trout, and charr, and is likewise depauperate in caribou (*Rangifer tarandus*), a terrestrial source of protein typically available to Arctic brown bears (Scott and Crossman, 1998; Nagy et al., 2005). While bears may exist on vegetarian diets, the consumption of meat has been linked to increased body mass, population density, and litter size in brown bears (Hilderbrand et al., 1999a, b; Rode et al., 2001). Arctic ground squirrels (*Spermophilus parryii*) and a limited number of semi-domestic reindeer (*R. t. tarandus*) are available to Mackenzie Delta bears; however, the exploitation of alternative sources of meat protein, such as fish, may be important to meeting bears' nutritional requirements and may serve as a major determinant of survival and fecundity (Nagy et al., 1983).

Broad whitefish (*Coregonus nasus*) are a riverine and anadromous species, distributed along the Arctic Ocean coast from the Ural Mountain drainages in Russia to the Perry River, Nunavut (Scott and Crossman, 1998). Broad whitefish undertake migrations from the Arctic Ocean and large rivers to smaller lakes and streams to feed, reproduce, and overwinter (Reist et al., 1987; Treble and Tallman, 1997; Tallman et al., 2002). During these migrations, broad whitefish may be vulnerable to predation by bears. Here we describe the predation of broad whitefish by at least one brown bear in the Mackenzie Delta region, Northwest Territories.

METHODS

The study area encompasses the Arctic boreal forest and upland tundra lying between the towns of Inuvik and Tuktoyaktuk and the adjacent Mackenzie Delta floodplain, Northwest Territories (Fig. 1). Pete's Creek (69°11′ N, 134°08′ W), located centrally in the study area, is a stream 16 km long and 1–3 m wide, lined with dwarf willow (*Salix*

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spp.). It flows northward across scrub tundra from a small, unnamed lake to the east branch of the Mackenzie River (Fig. 1) (Mackay, 1963).

Since 2003, an ongoing study has examined the food habits, movement patterns, denning, and reproductive ecology of brown bears in the study area. Between 2003 and 2007, 45 bears were fitted with Argos satellite-linked Global Positioning System (GPS) radio-collars that recorded GPS positions every four hours (Edwards et al., 2008).

In August 2007, eight bears were wearing GPS collars. For each bear, a random selection of GPS positions, recorded 24–48 hours apart, was investigated in the field for evidence of bear feeding activity. Site investigations were done from a Bell 206 JetRanger helicopter hovering at 5–15 m altitude, and a site description, available food resources, and signs of bear activity were recorded, as well as photographs of the site. Site investigations were conducted on 6 September and 2 October 2007.

To assess the possible use of the Pete's Creek area by study bears, we calculated annual 100% minimum convex polygon (MCP) home ranges for each GPS-collared bear in an ArcGIS database, using Hawth's Analysis Tools (White and Garrott, 1990; Beyer, 2004). For bears with 100% MCP home ranges incorporating Pete's Creek, we counted GPS collar locations that fell within 200 m of the creek's centre line.

RESULTS AND DISCUSSION

On 2 October 2007, while investigating GPS locations for a lone subadult female bear, our site investigation crew arrived at Pete's Creek. The temperature was -2˚C, there was 1–2 cm of snow on the ground, and the creek surface had recently frozen to a depth of 3 cm. Seven locations for investigation were adjacent to Pete's Creek. Three sites were located next to oxbow bends in the creek, two were centred on beaver (*Castor canadensis*) dams, and two were located in bankside willow thickets. We observed large numbers of tracks from wolves (*Canis lupus*), foxes (*Vulpes* spp.), ravens (*Corvus corax*), bald eagles (*Haliaeetus leucocephalus*), and at least one bear in the snow at all investigation sites. At the last site, we observed two patches of disturbed soil and vegetation 10 m from the creek bank, which upon investigation on the ground proved to be cached piles of partially consumed broad whitefish (25–40 cm total length), buried under approximately 20 cm of soil, moss, and Labrador tea (*Ledum decumbens*). Both caches were oval-shaped, about 150 cm long × 100 cm wide × 40 cm tall, and they were three metres apart. At least six grey, unconsolidated scats containing fish scales were in the immediate vicinity of the caches. A muddy, well-used trail led from the caches to a beaver dam bridging the creek, and ice in the pool upstream of the beaver dam had been freshly broken. Both the trail and excavated soil beside the caches showed clear pad and claw marks of a brown bear. Concerns about the proximity of bears precluded remaining at the cache site to count the cached whitefish.

After departure by helicopter, we observed a GPS-collared brown bear in a dwarf willow thicket at the creek edge, 400 m southeast of the caches. The bear remained in the willows until we approached within 100 m, and then ran into the open tundra. The bear appeared in excellent physical condition and was noticeably fat. Subsequent GPS collar locations suggest that this bear was the subadult female whose positions we had investigated.

We followed Pete's Creek southward to its source, where we observed a congregation of more than 20 ravens and five bald eagles at an unfrozen riffle. Upon investigation on the ground, we observed approximately 30 dead and dying whitefish in the 15 m stretch of unfrozen creek, with fish condition ranging from whole to almost entirely consumed. Our species identification of broad whitefish was determined from a fish collected at the site and was confirmed by Department of Fisheries and Oceans staff (T. Stein, pers. comm. 2007).

A review of GPS locations for the subadult female bear in question indicated that she remained in the vicinity of Pete's Creek from 26 July to 4 October 2007, during which time more than 59% of successful GPS locations (representing at least 796 hours) were within 200 m of the creek itself (Fig. 2). The bear's arrival at Pete's Creek corresponded to the reported downstream migration of large juvenile broad whitefish (30–45 cm) (Bond and Erickson, 1985; Reist and Chang-Kue, 1997), and her departure from the area on 4 October coincided with completion of winter freeze-up.

Annual 100% minimum convex polygon home ranges from seven (15.6%) of 45 GPS-collared brown bears in the study overlapped at least part of Pete's Creek, with three of the seven bears (including the one mentioned above) spending large amounts of time at Pete's Creek during the whitefish migration period. From 12 to 20 September 2003, an adult female with three cubs-of-the-year spent over 176 hours within 200 m of Pete's Creek (44 locations, 93% of successful GPS fixes). This same bear returned in 2004, spending more than 48 hours within 200 m of the creek between 27 July and 4 August (12 locations, 27% of successful GPS fixes). From 1 to 10 September 2004, another adult female bear spent more than 192 hours within 200 m of Pete's Creek (48 locations, 92% of successful GPS fixes) (Fig. 2).

Published reports of brown bears feeding on fish other than salmon, trout, or charr are rare. Siberian brown bears have been observed feeding on grayling (*Thymallus arcticus*) and pike (*Esox lucius*); Tajikistani brown bears have been reported to feed on spawning osman (*Dyptichus* spp.); and late medieval documents suggest brown bears in Norway once fed on spawning eels (*Anguilla anguilla*) (Storm, 1881; Vaisfeld and Chestin, 1993). The only evidence for bears feeding on fish other than salmon, trout, and charr in North America comes from the central Canadian Arctic, where small volumes of longnose sucker (*Catostomus catostomus*) remains were observed in fecal samples collected from brown bears in spring (Gau et al., 2002). Traditional knowledge reports from the Mackenzie Delta region,

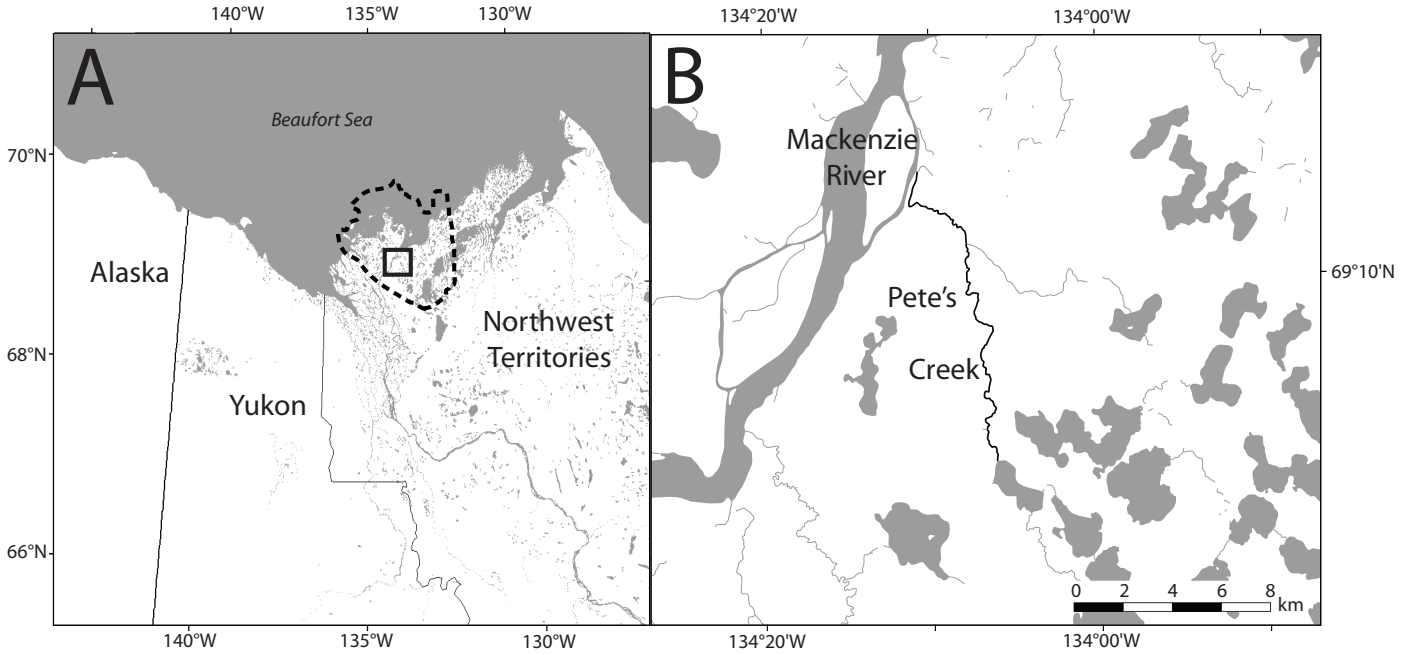

FIG. 1. Map (A) shows the location of the study area (dashed line) and the portion enlarged in B (black rectangle). Map (B) shows Pete's Creek (black line).

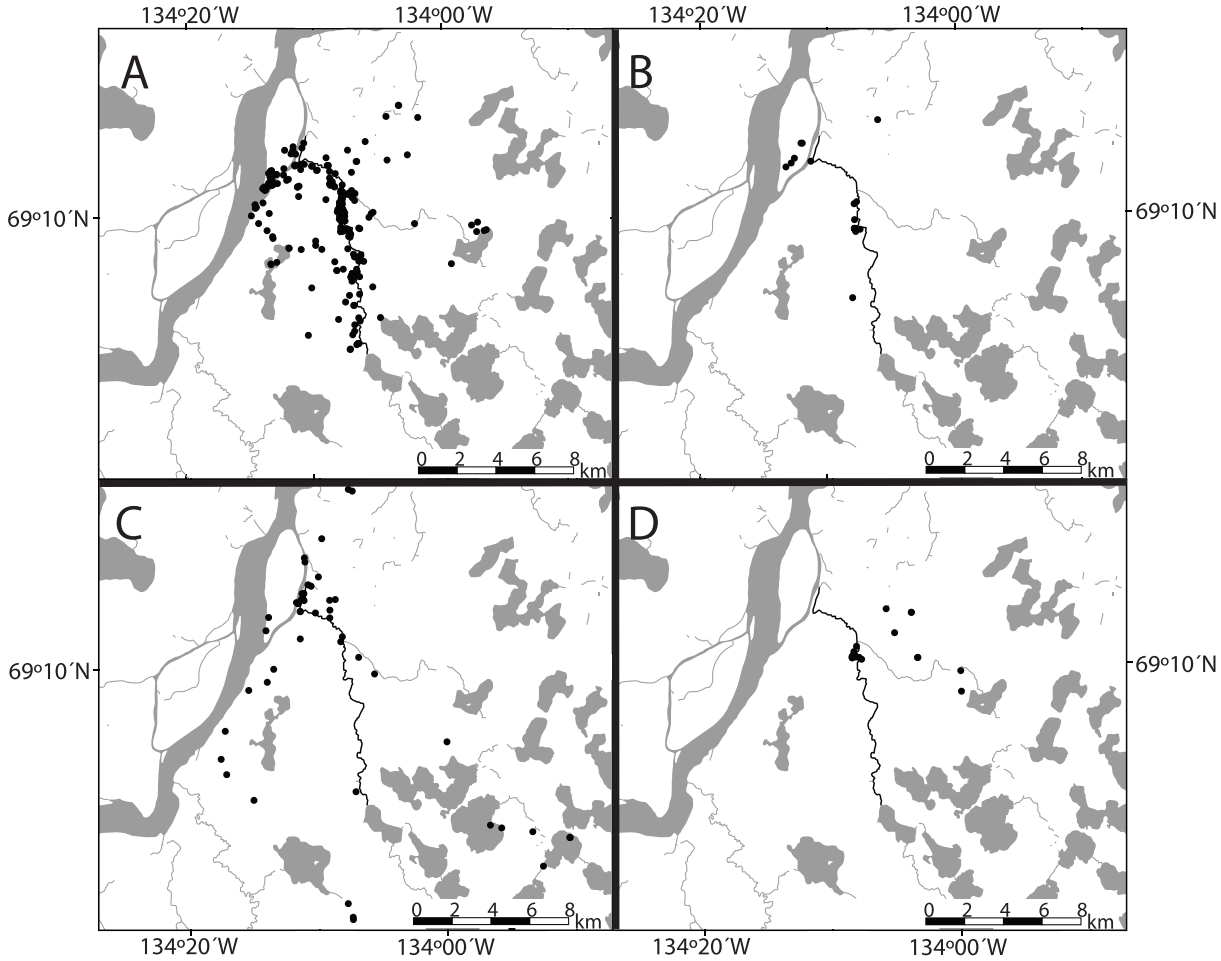

FIG. 2. Map of the Pete's Creek area, showing GPS locations of collared brown bears recorded at four-hour intervals (A) on 26 July – 4 October 2007, for a subadult female observed near cached whitefish on 2 October 2007 (n = 337); (B) on 12–20 September 2003, for an adult female with three cubs-of-the-year (n = 47); (C) on 27 July–4 August 2004, for the same adult female (n = 44); and (D) on 1–10 September 2004, for another adult female (n = 52).

however, state clearly that brown bears forage on whitefish, with Pete's Creek noted as an area where bears gather in late summer/autumn to take advantage of this seasonal resource (Fehr et al., 1997; MGP/ISR Working Group, 2006). Broad whitefish are abundant in the Mackenzie Delta area, feeding and overwintering in many tributaries and side channels of the Mackenzie River (Reist et al., 1987; Treble and Tallman, 1997; Tallman et al., 2002), and bear predation is likely at other streams as well.

Living at the northern limit of their range, with an active period as short as five months of the year, Mackenzie Delta bears face extreme pressure to gather adequate nutritional resources (Nagy et al., 1983). Meat, a highly digestible and nutrient-dense food, confers survival and reproductive benefits on bears consuming it, but access to typical meat sources for Arctic coastal brown bears (salmon, charr, and caribou) are limited in the Mackenzie Delta region (Scott and Crossman, 1998; Hilderbrand et al., 1999a, b; Nagy et al., 2005). A large, dependable source of meat, such as broad whitefish runs, could have a significant role in the fat and protein intake of some bears in this region. Predation on whitefish may therefore influence the fitness of bears exploiting this resource. The spatial concentration of fishing activity at streams during whitefish migrations means that disruption of foraging behaviour in these areas could have negative implications for some bears' ability to meet their nutritional requirements. The proponents of natural gas development in the Mackenzie Delta should consider that we do not fully understand the food resources of brown bears in the area, and that further investigation of these resources is warranted.

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REFERENCES

Beyer, H.L. 2004. Hawth's analysis tools for ArcGIS. http://www.spatialecology.com/htools.

Bond, W.A., and Erickson, R.N. 1985. Life history studies of anadromous coregonid fishes in two freshwater lake systems on the Tuktoyaktuk Peninsula, Northwest Territories. Canadian Technical Report of Fisheries and Aquatic Sciences 1336. 61 p.

Edwards, M.A., Nagy, J.A., and Derocher, A.E. 2008. Using subpopulation structure for barren-ground grizzly management. Ursus 19(2):91–104, doi: 10.2192/1537-6176-19.2.91.

Fehr, A., Davis, N., and Black, S. 1997. Nành' kak geenjit Gwich'in ginjik (Gwich'in words about the land). Inuvik: Gwich'in Renewable Resource Board.

Gau, R.J., Case, R., Penner, D.F., and McLoughlin, P.D. 2002. Feeding patterns of barren-ground grizzly bears in the central Canadian Arctic. Arctic 55(4):339–344.

Hilderbrand, G.V., Jenkins, S.G., Schwartz, C.C., Hanley, T.A., and Robbins, C.T. 1999a. Effect of seasonal differences in dietary meat intake on changes in body mass and composition in wild and captive brown bears. Canadian Journal of Zoology 77:1623–1630.

Hilderbrand, G.V., Schwartz, C.C., Robbins, C.T., Jacoby, M.E., Hanley, T.A., Arthur, S.M., and Servheen, C. 1999b. The importance of meat, particularly salmon, to body size, population productivity, and conservation of North American brown bears. Canadian Journal of Zoology 77:132–138.

Kistchinski, A.A. 1972. Life history of the brown bear (*Ursus arctos* L.) in north-east Siberia. In: Herrero, S., ed. Bears, their biology and management: A selection of papers and discussion from the Second International Conference on Bear Research and Management, 6–9 November 1970, Calgary, Alberta. Morges, Switzerland: IUCN. 67–73.

Mackay, J.R. 1963. The Mackenzie Delta area, N.W.T. Ottawa: Department of Mines and Technical Surveys.

MGP/ISR (Mackenzie Gas Project/Inuvialuit Settlement Region) Working Group. 2006. Inuvialuit Settlement Region traditional knowledge report. Submitted to Mackenzie Project Environmental Group by Inuuvik, Tuktuuyaqtuuq and Akłarvik Community Corporations. http://www.ngps.nt.ca/Upload/Letters%20of%20Comment/Inuvik%20Community%20Corporation/ICC-ISR_TK_Study/ICC_TK_Study.html.

Mowat, G., and Heard, D.C. 2006. Major components of grizzly bear diet across North America. Canadian Journal of Zoology 84:473–489.

Nagy, J.A., Russell, R.H., Pearson, A.M., Kingsley, M.C.S., and Larsen, C.B. 1983. A study of grizzly bears on the barren grounds of Tuktoyaktuk Peninsula and Richards Island, 1974 to 1978. Yellowknife: Canadian Wildlife Service.

Nagy, J.A., Wright, W.H., Slack, T.M., and Veitch, A.M. 2005. Seasonal ranges of the Cape Bathurst, Bluenose-West and Bluenose-East barren-ground caribou herds. Inuvik: Department of Environment and Natural Resources, Government of Northwest Territories.

Reinhart, D.P., and Mattson, D.J. 1990. Bear use of cutthroat trout spawning streams in Yellowstone National Park. In: Bears:

Their biology and management, Vol. 8: A selection of papers from the 8th International Conference on Bear Research and Management, February 1989, Victoria, British Columbia. 343–350.

Reist, J.D., and Chang-Kue, K.T.J. 1997. The life history and habitat usage of broad whitefish in the lower Mackenzie River basin. In: Tallman, R.F., and Reist, J.D., eds. The proceedings of the Broad Whitefish Workshop: The biology, traditional knowledge and scientific management of broad whitefish (*Coregonus nasus* [Pallas]) in the lower Mackenzie River. Canadian Technical Report of Fisheries and Aquatic Sciences 2193. 63–84.

Reist, J.D., Bodaly, R.A., Fudge, R.J.P., Cash, K.J., and Stevens, T.V. 1987. External scarring of whitefish, *Coregonus nasus* and *C. clupeaformis* complex, from the western Northwest Territories, Canada. Canadian Journal of Zoology 65: 1230–1239.

Rode, K.D., Robbins, C.T., and Shipley, L.A. 2001. Constraints on herbivory by grizzly bears. Oecologia 128:62–71.

Scott, W.B., and Crossman, E.J. 1998. Freshwater fishes of Canada. Oakville: Galt House Publishing.

Storm, G. 1881. Samlede skrifter af Peder Claussøn Friis. Kristiania: U.W. Brøgger.

Tallman, R.F., Abrahams, M.V., and Chudobiak, D.H. 2002. Migration and life history alternatives in a high latitude species, the broad whitefish, *Coregonus nasus* Pallas. Ecology of Freshwater Fish 11:101–111.

Treble, M.A., and Tallman, R.F. 1997. An assessment of the exploratory fishery and investigation of the population structure of broad whitefish (*Coregonus nasus*) from the Mackenzie River Delta, 1989–1993. Winnipeg: Canada Department of Fisheries and Oceans, Central and Arctic Region.

Vaisfeld, M.A., and Chestin, I.E. 1993. Medvedi: Bury medved', bel'yy medved', gimalayskiy medved' (Bears: brown bear, polar bear, Asian black bear). Moscow: Nauka.

White, G.C., and Garrott, R.A. 1990. Analysis of wildlife radio-tracking data. San Diego: Academic Press.